SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1579.—Vol. XXXV.] LONDON, SATURDAY, NOVEMBER 25, 1865. STAMPED.... SIXPENCE. UNSTAMPED. FIVEPENCE.

SOUTH WALES INSTITUTE OF ENGINEERS.

The annual meeting of members was held at the Westgate Hotel, Newport, on Nov. 15,—Mr. W. Menelaus, the President in the chair.

Among the members present were—Messrs. Lionel Brough and T. E. Wales, two of Her Majesty's Inspectors of Mines; Mr. Alex. Bassett, Cardiff; Mr. Wilkinson, Cwmpenner Colliery, Aberdare; Mr. Maynard, Crumlin; Mr. Jacob James, Newbridge; Mr. Rudolph Bodmer, Newport; Mr. L. T. Lewis (agent for Lord Dynevor), Mardy, Aberdare; Mr. Cox, Caerleon; Mr. William Bevan, Tredegar; Mr. David Williams, Aberaychan; Mr. John Brogden, Tonddu; Mr. Bedlington, Rhymney; Mr. T. Dyne Steele, Newport; Mr. W. Jones, Dowlais, Mr. George Fowler; Mr. John Geo. Weeks, Machen; Mr. Chas. Maynard, Bedwas; Mr. Goodrich, Llangholm, Gaveller's Office, Coleford; Mr. Geo. Lewis, Coleorton, Ashby-de-la-Zouch; Mr. Alfred Clayton, London; Mr. E. J. Edwards, Crumlin; Mr. Charles E. Harrison, Machen; Mr. Matthew Bates, Risca; Mr. T. E. Cooke, Newport; Mr. R. S. Prosser, Newport; Mr. C. Simpson, Newport; Mr. W. B. Brain, Forest of Dean; Mr. William Mayis; Mr. B. Farleigh; Mr. W. B. Monks; Mr. T. Foster Brown, Machen; Mr. Birbeck; Mr. Hussey; Mr. W. Howe, Clay Cross Collieries; Mr. Woollett, town clerk, Newport; Mr. Scott Russell, Cardiff; Mr. W. Rogers, Mr. Thos. Williams, Mr. John Williams, Mr. James Murphy, Newport; and Mr. E. Brigden, secretary. Amongst the plans, diagrams, &c., exhibited were—Elevation section of pump for Cornish engines; ram pump, 18-in. diameter, 10 ft. stroke, at Clay Cross Collieries; hand gear for pumping-engine, 84-in. cylinder and 10 ft. stroke; cylinder and nozzles for Cornish pumping-engine, cylinder 84 in. in diameter and 10 ft. stroke; a photograph of Newport Bridge in course of improvement on the plan proposed by Mr. T. Dyne Steele, C.E.; a photograph of Charing Cross Railway Bridge; an excellent drawing of the *Mallorca* iron-clad was also shown. In connection with the papers read there were diagrams exhibited of endless rope gearing, tail-rope engine, &c.

The Chairman read the minutes of the preceding meeting, and apologised for the absence through ill-health of Mr. Martin, the President elect. He explained that the financial position was very satisfactory. The balance at the bankers last year was 100*l.* 17s. 4d., and the receipts for the year 214*l.*=314*l.* 17s. 4d. The expenditure had been 179*l.*, leaving 135*l.* in hand. There was likewise 400*l.* arrears of subscription (good debts) due to the society. The officers elected for the ensuing year were—President, Mr. George Martin, of Dowlais. Vice-presidents, Mr. John Brogden and Mr. Cox, re-elected. Members of Council, Mr. E. Rhys and Mr. B. Kirkhouse, re-elected; and Mr. David Thomas, David Joseph, W. T. Lewis, and Mr. Maynard. Mr. H. J. Evans was re-elected treasurer, and Mr. E. Brigden secretary. Messrs. J. G. Weeks, Machen; C. Maynard, Bedwas; G. Langholm, Coleford; G. Lewis, Coleorton; A. Clayton, London; and E. J. Edwards, Crumlin.

DESCRIPTION OF AN EQUILIBRIUM SLIDE VALVE FOR STEAM-ENGINES.

BY MR. WM. HOWE.

The object of the author is to relieve the valve from pressure to any practical extent, without materially increasing the rubbing surface, and for this purpose two valves to each cylinder are placed back to back, working over double ports opposite and parallel to each other, each set of ports being only half the area required for such cylinder: thus two sets of ports merging into one port leading to each end of the cylinder is adopted, or the ports from the two faces may pass forward separately into each end of the cylinder. Valves of this description have been applied, and are working at the Clay Cross Works, where the steam is admitted into the steam-chest surrounding the valves, and escaping through the centre; or the steam may be admitted within the valves in the centre, and escape at both ends outside the valves. For comparison, two drawings were exhibited, the first representing a new valve applied to an old horizontal winding-engine, where it was driven by one eccentric loose on the fly-wheel shaft, and worked by a separate handle for starting, regulating, checking, and reversing by hand—the cylinder of this engine being 20 in. in diameter, with a stroke of 3 ft. 6 in., and 600 or 700 tons per day being drawn by it from a depth of about 80 yards; the second intended to represent the common slide valve for the same diameter of engine as that above referred to, with the same steam lap and same proportion of ports to area of cylinder. The area of this valve is 132·81 square inches, and the steam pressure 50 lbs. per square inch, equal to 6640 lbs. weight on the back of the valve. The area of the steam to act upon the valve in the altered engine is 28 in. on each valve, or 56 square inches on the two valves, and the steam-pressure, as above, being 50 lbs. per square inch, equals 2800 lbs. weight on the back of the valves. The weight required to overcome the friction of the slide-valve is about one-fifth of the weight on the valve, thus a saving of about 60 per cent. is made in the power required to move the valve. It will be seen that according to the construction of this valve there must be a surplus pressure acting on the back of the valve amounting to about the area of the steam-ports, as, if this were not the case, the moment the steam-port was opened the pressure acting on the face of the valve would blow it off the cylinder face; but in the dimensions given there is a pressure acting on the back of the valve equal to 11 square inches above the actual area of the two steam-ports—this is purposely done, in order to ensure a perfectly tight joint between the valve and cylinder face. A slide-valve of the ordinary construction would have an area of about 256 square inches for the steam to act upon, and this at 50 lbs. steam pressure per square inch would be equal to about 12,750 lbs. weight on the valve; the valve shown in the drawings only represents about 36 square inches for the steam to act upon each valve, or 72 square inches on both valves; and this at 50 lbs. pressure equals 3600 lbs. total weight on both valves. The old valve would require about 2550 lbs. on the valve-spindle to work it, but the new valve would only require about 720 lbs. to move it, being a saving of power required to work the valve of at least 70 per cent. in favour of the new valve. The paper concluded by saying that the valves are kept one-sixteenth of an inch apart: this is to prevent them sticking, by unequal expansion, between the duplex faces, and an iron ring is placed round this place to prevent the India-rubber packing being forced by the steam into the space between the valves; the iron ring is not necessary in the valve shown in the altered engine. The India-rubber packing first applied has been at work twelve months, and shows no signs of leakage, but should it do so a cost of 2*s.* or 3*s.* and an hour of time would be sufficient to replace it; there would be no difficulty in applying metallic packing, instead of India-rubber; but as the India-rubber is so perfectly tight is is thought best for the purpose.

The Chairman said he need not inform the meeting that the paper was one of very great importance, and if the slide-valve could be made applicable to colliery engines generally Mr. Howe would confer a great boon. But, as they had engines 25 inches in diameter, he thought it became difficult to get over it. Mr. Howe's plan was to have the passage a little larger than on the old plan. He had no doubt there were gentlemen present who would have something to say on the matter, and Mr. Howe would be happy to explain his views, and answer any questions that might be put to him.

Mr. W. Moyle agreed with the Chairman as to the importance of the subject. He understood from the paper that Mr. Howe said he saved one-third of the coal by the new valve, and he should like some information on that point.—The Chairman thought Mr. Howe meant that there would be one-third saving of the power in working the valve—that one-third of the power now in working the common valve was saved by using his.—Mr. Howe said that the construction of the equilibrium slide-valve was not at all calculated to save fuel, but when applied to an old engine, as shown in diagram No. 4, such may be the case. They applied it to an old engine they had at work for 25 years. The old valve was taken off, and only one-eighth of the lap left. He put the new valve on, and gave it only one-half an inch of that, so he apprehended that it was by luck the fuel was saved. The engine to which the new applied had a 20-in. cylinder and 45 lbs. steam, and he could assured the meeting it was exceedingly heavy to handle it, but now it again worked with the greatest possible ease, so they had not thought it might to apply the link motion to the engine, and it was made 25 years ago, before the link motion was thought of. By reducing the lap to one-eight of an inch the valves are much shorter to work that when they got half an inch.

The Chairman said Mr. Howe had made himself perfectly clear. His plan did not effect a saving in fuel but in the power; it was more easily handled, and was applicable to engines of moderate size.—Mr. Brough apprehended there was danger in the lap.

Mr. Byers thought they were apt to put too much strap on winding-engines, and he held it was much easier to work with the least possible area at the back of the valve. He thought Mr. Howe's was a good plan, and ought to be applied to large engines. He had always advocated the slide-valve to colliery engines, as then they were much easier to work.—Mr. Moyle said he was perfectly satisfied with the explanation given.

Mr. Hussey was of opinion that if the valve was to slide against a plate with resistance equal to the area of the ports, and directly opposite, the same advantageous results would follow. In this case it could be applied to a considerable less cost, and, what was more important, it would dispense with the loss of steam each stroke of the engine occasioned by the additional ports. And, again, it could be applied to the engines at present at work at, at least 60 per cent. less cost. In this case it would be necessary to have a communication from under the upper valve with the atmosphere or condenser, as the case may be.—Mr. Moyle said Mr. Howe suggested a balance plate at the back of the valve. No doubt equilibrium was a very nice thing in theory, but the fact was he found no end of trouble with it; in fact, it did not work. Still he must say that Mr. Howe's plan was the best to overcome all the difficulties he had hitherto met with.

Mr. Howe said his plan was not exactly an equilibrium valve, but as regarded its working he could only say he had one in working two years, and it was now in perfect working order.—Mr. Huzzey argued that his application would not alter Mr. Howe's plan at all.—The Chairman said he must say that his experience in slide-valves agreed with that of Mr. Moyle, as they always had been a difficulty to him. A great many attempts had been made, but most of them had been failures, and every attempt he had been connected with had all been failures. If the valve of Mr. Howe's will work in keeping order and steam-tight it was a great improvement on the old valve. He could say that if Mr. Howe's invention bore the test of practical working it would be a very valuable one.

Mr. Howe said, that as he was a pattern maker and moulder perhaps he was better able to go into the subject than other persons. Now, he had to employ the link motion on winding-engines, and that led him to adopt the principle laid before the meeting. They had four valves at work, and they had arranged to put the valves in a pair of engines with the largest size cylinder of 30 inches. The plan was brought out some years ago by Mr. Wilson, and was tried in a machine-engine, but it was not tight, and the plan failed. He might be allowed to say that he was the inventor of the link motion, some 23 or 24 years ago, when he was a workman at Stephens's Foundry, and about 18 or 19 years since he put it in an engine at Clay Cross Works, which was the first application.

ON A NEW MINING AND LAND SURVEYING THEODOLITE.

In the paper on this subject, Mr. H. D. Hoskold stated that his principal object was to bring before the Institute a new form of Mining Theodolite, invented by himself. One peculiarity in this instrument consists in its having a telescope fixed to each plate, one of which represents the zero of the plate carrying the vernier, and the other the zero of the lower or graduated plate, each having an independent motion. This object is effected by abandoning the old form of construction adopted for the main axis—which worked concentrically in each other—and substituting in their places a single axis, screwed to the under side of the lower plate, and passing through the parallel or levelling plates, is screwed to the end of a ball in the socket joint. This main axis is constructed with an elongated hole or slot through its centre, in the sides of which a short transit axis is fixed, and into which a telescope is screwed, forming one piece with the axis. Mr. Hoskold is aware that the theodolite has been much objected to on account of its height, the trouble and difficulty of setting it up at each station, and the time required and consumed in the necessary manipulation; but he is persuaded that these objections cannot any longer be urged against the general introduction of this kind of instrument for mining purposes. It may, probably, be argued that in the system of observations generally employed—that of referring the preceding forward angle to the back station—a more accurate system could not be employed; but in making the wires coincide with the back lamp, it is quite possible that a man may give motion to the upper instead of the body tangent screw, and thereby ruin all his work without being able to detect which angle is the incorrect one, without going over all his work again. Again, presuming that the bi-section was made by the right screw, after the upper plate is released to get the forward sight, the legs of the instrument might slip a little—sufficient to throw the plates out of the horizontal,—and, consequently, give an incorrect reading. All these little inaccuracies, which so much damage and confuse the work when it comes to be plotted, are entirely avoided by employing the instrument under consideration, for the lower telescope represents the back station, and is always a fixture; and when the bi-section is once made, we can instantly examine it by looking through the telescope at the instant the upper telescope wire is fixed on the forward lamp, and if any displacement has taken place it is as quickly put right; we may, therefore, consider the telescope, independent of its other uses, as an effectual check on the whole proceeding. It now only remains for the observer to be certain of his readings, and this may be always known by reversing the instrument and measuring the supplementary angle; this, together with the former angle, should make up the circle. To expedite the setting up of the theodolite, Mr. Hoskold has invented a new portable kind of stand, with a traversing plate. The legs are made telescopic, so that they can be used any required length, according to circumstances, the necessary clamps being provided at each joint to keep the slides in any desired position. The three legs are attached by joints to a 6-in. circular hollow brass box, in which is contained a traversing or moveable plate, which moves from the centre just an inch. A large male screw is constructed in the centre of the traversing plate on which the theodolite is screwed, all moving together in and on the circular box. By means of this portable traversing stand, the theodolite can be set up with much less trouble, in less time, and with a nearer approach to geometrical accuracy than by the ordinary method. The stand is first set up over the station, as near as can be estimated by the plumb-bob, the body of the theodolite is then turned to the left, or unscrewed from the traversing plate screw half a turn; a little pressure is then applied to the body of the theodolite, which causes the traversing plate to move, carrying with it the theodolite and plumb-bob suspended beneath; this motion is continued until the vertical axis of the theodolite, determined by the plumb-bob, coincides with the centre of a stationary object; the theodolite is then turned back to the right half a turn, and by the friction of the bottom parallel plate on top of the traversing plate box all is made instantaneously firm and secure.

The Chairman said the writer of the paper was not able to attend, but he understood there was a friend of his present who would answer any questions which might be asked.

Mr. W. B. Brain said Mr. Hoskold had made reference to him in respect to his plan for testing bearings, and if any gentleman had a question to ask upon the subject he would, if it lay in his power, answer him. With regard to the instrument he could only simply say that he had used it, and found it the most efficient and correct he ever saw for underground purposes, and there was very little variation in the plates in consequence of not having been brought to zero. Now, he begged to say that his system of testing bearings was not like Mr. Hoskold's. They resembled each other in theory, but not so much in practice, for if the first bearing should be in error all the others reduced from it would be in error in proportion, and subject to a second reduction to put them right. He took every bearing as read from the needle, and deduct it if north-east or south-west, and add it if south-east or north-west to the angle. That gave him the angular difference between the magnetic and assumed angular meridian, and the majority of those bearings which make the same difference of meridians he took to be true. By those means the true bearing of the first line or assumed angular meridian was ascertained, and then all the bearings in error could be got right from this tested line. He then proceeded with the subterranean survey in the same manner, and when tested united it to the surface survey; and when a double proof of its accuracy was required, he placed the transit theodolite firmly in an inverted position over the top of the shaft, and after carefully levelling it, apply a diagonal eyepiece and bisect two lamps one on each side of the bottom shaft in a direct line in centre of road from the bottom, and produce that line on the surface and unite it to the surface survey, then go down the shaft and unite it to the subterranean survey; by this means the subterranean and surface survey could very easily be connected matematically accurate without the aid of bearings, although he found the bearings useful as a rough check in surveys of considerable extent.

Mr. Brown: How many observations can you take in an hour?—Mr. Brain: Well, it would be difficult to take more than six observations with the theodolite.

A Member: What is the weight of the instrument?—Mr. Brain: Its weight is not more than 13 tons. I have used the instrument where the seams have only been 20 in.

Mr. Bedlington said the difficulty was the largeness of the instrument, and the only advantage over the ordinary instrument was the telescope.—Mr. Brain said that, having a dialling on top of the telescope bearings, it could be taken very easily without any observation.—Mr. Bedlington observed that the legs would have to be spread out very much to get a compass at the top.—Mr. Brain replied that he used a short stand with the legs only 1 ft. in length; they spread out very low.

Mr. Bedlington: Do you take observations on your knees?—Mr. Brain: You cannot well stand up (laughter).—Mr. Bedlington thought they could with ordinary care make surveys with the ordinary compass.—A Member: Was any bottom stone taken up in the 20-in. seam?—Mr. Brain: Not any at all.—Mr. Bedlington: Do you think you cannot make sufficient correctness with the ordinary compass?—Mr. Brain: I never could over bridge rails—wrought-iron rails. I assume an angular meridian. I never take a magnetic meridian at all.

Mr. Brown: I think it must be admitted that for all practical purposes a miners' compass is sufficient. I think the fact of the theodolite being so heavy, and that it can only take six observations in the hour, must destroy all hopes of its being employed generally.—Mr. Brown then proceeded to show how, by striking out a line from the surface to the bottom of the pit, he did away with magnetic meridian.—Mr. Bedlington felt that they ought not to get into a discussion of the theodolite against the compass, which he thought they were rather getting into, through his fault.

The Chairman thought the meeting would be in order in arguing the matter as between the theodolite and the compass, inasmuch as Mr. Hoskold said the theodolite did for underground surveying.—Mr. Bedlington said it was no doubt a perfect instrument for surface purposes, but the difficulty was the using of it for underground, and that had prevented its being used more extensively. Mr. Brain was right in saying that he could assume any meridian he liked, and gain the surface underground. They could assume that as the basis, but it was usual to lay down magnetic meridian as a basis in all underground plans he knew of. If they did they might start with a series of angles, but then they were liable to error in the first start from attraction of iron. Therefore if they used angles instead of points of the compass they got a perfect survey. Mr. Brain said he could not start with a magnetic meridian, but he assumed a meridian; such might do for surface survey, but it was not usual in collieries.

Mr. Brain begged to say that he always laid down magnetic meridian as well as his assumed meridian. If there was a survey of not much importance he should work by the compass, and he should not use the theodolite unless in work of great nicety.—A Member: Have you ever seen the Hedley dial, which has both a compass and a theodolite without the telescope; it will take angles without the needle, and at the same time take your bearings.—Mr. Brain: I have seen a drawing of them.

A Member: Can you read from four or five minutes on the compass?—Mr. Brain: With the vernier you can.

After some further questions and answers, the Chairman said he thought Mr. Brain had met fairly and manfully all the objections raised. It was not for him (the Chairman) to say who had the best of the argument. Had any gentleman any more questions to ask, or any objections to make?—Mr. Weeks: Have you any objection to a plumb line hung down by the side of a shaft?—Mr. Brain replied that he never used them, because of their oscillation.—Mr. Monk said he had used Hedley's dials, and he had always found them to work well. He had made many surveys, driven several stone drifts, and sunk pits, and, therefore, he considered Hedley's dial well adapted for underground purposes; taking the angles and needles conjointly, they could perform underground surveys most correctly.—Mr. Brown said he thought Mr. Brain's system more corret than any dial in taking a survey.

The Chairman said Mr. Brain had acquitted himself very well in maintaining the usefulness of his friend's instument. (Applause.)

THE CORNISH PUMPING ENGINE.

The Chairman said the meeting had had the opportunity of seeing several drawings in relation to the Cornish pumping-engine, which had been kindly lent by Mr. Howe. Perhaps he might be allowed, on behalf of the Institute, to ask Mr. Howe to add to the obligation they owed him by writing a paper on the Cornish pumping-engine, which was a subject of vital importance, more especially as they were about sinking deep shafts. (Applause.)—Mr. Howe said he would endeavour to comply with the request of the President. (Applause.)

THE LEINSTER COAL FIELD.

The Secretary read a paper on the Leinster Coal Field, by Mr. J. M. Meadows.—On the proposition of the Chairman, seconded by Mr. Brough, a vote of thanks was accorded to Mr. Meadows for his very interesting paper.

UNDERGROUND HAULAGE, PARTICULARLY IN REFERENCE TO ENDLESS AND TAIL ROPES.

BY MR. GEORGE FOWLER.

The paper commenced with an explanation or the present mode of operation connected with both plans, showing under what circumstances which it would be more advantageous to employ, but at the same time considering each system superior to simple horse power, that where the one would cost 8d. the other would only cost 3d. The endless rope was the one which the writer appeared to think superior on the ground of cost, and also preventing the machinery being stopped for any length of time from the trams getting off the line. Also, old rope could be used for the purpose, which could be easily repaired, although he recommended a wire-rope. He afterwards gave the old price for horse labour at 8d., and then the price by the system of the endless ropes, taking the raise of the colliery at 500 tons per day, a pair of engines with 15-inch cylinder would cost 2500*l.*, and at 15 per cent. this sum represents 375*l.* This included the engine-house, three boilers, and all the parts required for working. Taking the quantity of coal raised as 500 tons a day, and there were 256 working days in the year, would give such an amount, divided by the expenses, as would show the cost to this point would be about ¾d. per ton. There would be required about 6000 yards of rope, which would amount to 520*l.*, and as this rope would last about two years, there would be a further expense entailed of about ½d. per ton. There were other expenses attached, which he calculated would increase the sum to about 3d. per ton. The paper entered very minutely into the subject, showing not only the extent and capability of the endless rope, but also showed the kind of roads best adapted for the endless and the tail ropes, and the rate of speed best calculated to insure correctness in the working and less liability to accident. Turning the rope in the form of the figure 8, though one that would insure the bite of the rope more than by the other form, would seriously damage the rope, from the constant bending backwards and forwards, and it would thus wear out considerably faster than by the ordinary means.

The Chairman said that as Mr. Fowler was present, and as he lived a long distance off, he thought it would be only showing Mr. Fowler proper etiquette if they departed from their usual rule, and discussed the paper then. He would ask Mr. Fowler if he had seen or knew anything of the clip-drum? They found that instead of this system it was common in the North to fasten the rope two or three times round the pulleys.

Mr. Fowler said he did not. He knew where it worked on the surface for a short distance of about 200 or 300 yards. He had not seen it underground, or heard of it to a greater extent then from 1000 to 2000 yards.—The Chairman: Because if you get the clip-drum, instead of passing the rope round the pulley you would be able to work the rope much easier, and with less wear. I have not seen it work, but it seems to answer well in steam-ploughing for agricultural purposes.—Mr. Fowler pointed out the danger of damaging the ropes, as the clip pieces came on them.—Mr. Brough said the endless rope was not much in use underground; it was the tail rope that was used.

The Chairman said the writer of the paper had not made up his mind which was the best, and the subject was an open question; so far as his experience went, he could not say which was the best.—Mr. Brough said the endless rope was one of endless difficulty. (Laughter.) The tail rope was generally used in the North.

Mr. Fowler said that in his district they had but two endless ropes, which answered very well. If an accident happened to a tail rope by its breaking, the trams were delayed two or three hours; but with an endless rope, suppose a tub got off the rails, the train was stopped, and the fault was rectified; or suppose the rope broke, the engine stopped at once, and the defect was easily and simply rectified. The endless rope could only be used where the road was level. They had a line 2000 yards long, and an incline plane; the work was carried on by the same engine, one portion being worked with a single rope, and they found no difficulty in applying the two. They worked 400 or 500 tons per day by one engine with an endless rope.—Mr. Brough: That is not very much.—The Chairman: It is rather a large amount of work.

M. Brough remarked that he knew of an iron endless rope which weighed 1500 tons. He should like to know what amount of deviation from a straight they worked this endless rope.—Mr. Fowler said it could be worked to any curve they liked. He worked a curve of 90 degrees.—A Member: You surely could not go round that?—Mr. Fowler: I could go round it easily.

Mr. Bedlington said he had seen a lot of those ropes. He had seen an endless rope on a level of 1900 yards one way and 1700 yards in another direction, worked by the same engine very satisfactorily. In working an endless rope a man stood in front of the train; he just clipped the rope, and there was no occasion to have the tubs at all. If it were wished to get coal off at different stations he lets go the rope. In fact, there was no difficulty whatever in working an endless chain-rope. Then, again, there was the tail rope, which might be best in some cases. The advantage in the endless ropes was that they could work them to the utmost, because there was no danger if they should happen to break. But on inclined plains there would be danger with a tail rope, as the train would run back if it got off the rails. The speaker then proceeded to point out how well the endless rope worked. They found one small engine working a length of chain 2000 yds. long, but it was very firmly balanced. If the full tubs came down hill the empty tubs were going up. The fact was the chain was nicely balanced, and carried on the tubs. They had only to put a train on the line of chain, the chain clipped, and it was taken up. He next pointed out how they worked at right angles, and mentioned that one engine worked two roads, 10,436 yards in length. He thought it was the most admirable system he ever saw; and, whatever the first outlay was, he considered it would be less expense in the long run, because of the less expense in renewing the rope.

Mr. Brough: Have you the power, the weight of the chain, and the quantity of product brought out?

Mr. Bedlington replied that the engine was a 12½-in cylinder, with 30 lbs. of steam. The cost of the engine was 2*s.* 8*d.* per day. The quantity worked by it was 229 tons, in about six or seven hours. They could calculate the weight of chain, as the length of it was 10,436 yards, and its exact size was five-eighths.—Mr. Brough: This is, in

dead, a marvel in engineering. Do you attribute it all to balance? We really shall come to perpetual motion by-and-bye. (Much laughter.)

Mr. Bedlington said it seemed to be done principally by balance. He would give the address of the colliery to any gentlemen who would like to see for themselves, and he had no doubt the agent would be glad to show them over the pit. In reply to a question, Mr. Bedlington said they were straight lines, and when they wanted to go off at an angle they must use sheaves. In reply to the Chairman, he said that if the endless rope was applied to the South Wales district they would be bound to have the coal on a level with the woodwork, and to have iron trams.

The Chairman said it would not be applicable to this present system, as this coal was too large.——In reply to a question, Mr. Bedlington said, suppose in coming down a tub slipped it would be blocked against the next.——Mr. Bassett said the weight of this chain would keep the tub from slipping off. He saw an endless rope on a slight incline not more than half a mile long at Manchester. The chain was very heavy, and kept the tubs all in their proper places. He could not understand how they got away if they wanted to go into right angle roads.——Mr. Bedlington explained this, but only a portion of his remarks were heard by the reporters.

Mr. Bassett said he was at a meeting of the North of England Engineers, at Manchester, when a discussion took place about the endless and the tail rope; the arguments on both sides were so even that the question became a most difficult one, and the members appointed a committee of three or four to investigate the whole matter, and report the result they arrived at. He hoped they should have another opportunity of still further discussing the matter.

Mr. Bedlington: It is evident, whether it be an endless rope or a tail rope, something more must be done in that way in Wales.——Mr. Bassett: What kind of rope does Mr. Fowler suggest.——Mr. Fowler: Steel wire-ropes.——The Chairman said the discussion ought not to be closed, but Mr. Fowler ought to have an opportunity of hearing what Wales had to say; therefore, it would be kept open till the next meeting, and, in the meantime, the paper would be printed, and gentlemen in and out of the district would get a good amount of information.——On the motion of Mr. Bassett, seconded by Mr. Bedlington, a vote of thanks was passed to Mr. Fowler.

The Chairman said he could not leave the chair a second time without thanking them heartily for their confidence, and he felt happy in being able to congratulate them on the success of the Institution, which he thought its first promoters hardly expected. They had to thank those gentlemen for the interest they had taken in the Institution, and he was glad they had selected one of the most worthy of them to succeed him in the chair he now vacated in favour of Mr. Martin.

The members then adjourned to a splendid dinner, served up by Mr. Hallen in his well-known style. The viands, champagne, and wines were of the first quality, and a very pleasant evening was spent under the presidency of Mr. Menelaus. The usual loyal toasts having been honoured, Mr. A. Bassett said he rose to propose "The Town and Trade of Newport," which was essentially the toast of the evening. Connected as he was with the Alexandra Docks, and agent to Lord Tredegar, he felt the deepest interest in the port. The inhabitants of Newport had been for a long period in a lethargic state, but he was happy to say that during the past two years they had made great efforts to put the port in its proper position. It possessed a magnificent tidal column, and he saw no reason why Newport should not have the finest docks in the world, and everything was being done to attain that object, and he believed that in the course of a few years the object would be attained. He need not tell them that they had an inexhaustible store of minerals in the background, and he was perfectly convinced there was not a seam of coal in the district, however deep, but what could be worked with success. They could not expect to accomplish this at present, or perhaps for years; but he had no doubt whatever that eventually the lower seams would be worked. In other districts seams were worked at a depth of 600 and 700 yards, and he saw no reason why they should not do the same in the Monmouthshire coal fields (cheers).

TREATMENT OF POOR AURIFEROUS AND ARGENTIFEROUS ORES AT SCHEMNITZ, IN HUNGARY.

BY ADOLF PLAMINEK.

The mines in the neighbourhood of Schemnitz supply the reduction works with poor ores, which, with regard to their metallic contents, may be divided into two classes—auriferous ores and argentiferous ores. The first of these may be again divided into auriferous lead ores and auriferous mundic ores. There are four separate districts in which the mines are located, the first and largest being the Windschacht district, containing the mines Andreas shaft, Sigismund shaft, and Pacher level, on the Spital main lode, and the Segengottes level, on the Theresia lode. These all produce auriferous lead ores. The Maximilian shaft, on the Spital lode, producing auriferous mundic ores; the Ferdinand shaft, and Carolus shaft, on the same lode, producing silver ores only. There are also in this district four other mines producing the last description of ore, situate on three lodes, called respectively the Biber, the Grüner, and the Stephan lodes.

In the second, or Eisenbach district, is the mine Alt Anton Level, working on miscellaneous lodes, producing auriferous mundic ore. The ores from this mine might more properly be placed amongst the argentiferous ores, but as a little gold is obtained by amalgamation I have preferred putting them in this class. In the third, or Hodritch district, are two mines, situated respectively on the Alt and Neualterheiligen lode, and the Colloredo lode. These mines produce only silver ores. There are also in this district several private mines which, in consideration of their using a deep adit level (belonging to the Government) for drainage purposes, pay a royalty of 1-10th; this royalty is paid with the ore as broken, 1-10th of the quantity raised being delivered to the Delius reduction works, and there dressed by themselves. The fourth, and last, is the Konigsberg district, in which is the Althandel Mine, working on miscellaneous lodes, producing silver ore. The auriferous lead ores are composed of a red-coloured quartz, mixed with argentiferous lead ore, as well as with sulphurets of copper, iron, and zinc, and containing gold in such small particles that its presence cannot be detected with the eye, even when aided by a powerful glass. The average contents of this ore is per ton 1 dwt. 22·08 grs. of gold, 16 dwts. 1·92 grs. of silver, and 63·6 lbs. of lead. The auriferous mundic ores are composed of a greyish quartz, mixed with sulphate of baryta, a clayey decomposed greenstone, argentiferous mundic, and, as before, very minute particles of gold. The average contents of this ore is per ton 1 dwt. 20·93 grs. of gold, and 16 dwts. 7·68 grs. of silver. The argentiferous ores, from which is extracted only silver, are composed of quartz, somewhat similar in appearance to the quartz composing the auriferous mundic ores; it is mixed with a decomposed clayey greenstone and argentiferous mundic, with occasional specks of sulphuret of copper, argentite, polybasite, stephanite, pyrargyrite, and prousite. The ores from the Grüner lode are largely mixed with a clayey decomposed greenstone, and are, therefore, washed before stamping. The average contents of these ores are, for every ton of stuff, 16·128 grs. of gold, and 1 oz. 12 dwts. 15·36 grs. of silver. This yield of gold being so small, it is not extracted by amalgamation, but is left in the silver with which it is obtained in the smelting process.

These results are taken from the statistics of the year 1860, and are the mean average per ton of the whole year's working. The following quantities of different classes of ores were raised and dressed during that year:—

Auriferous lead ores	Tons 41,670
Auriferous mundic ores	18,504
Argentiferous ores	39,884=99,858

This large quantity of ore, of course, requires proportionately extensive reduction works. The following is a list of machines, &c., employed to treat the above quantities:—180 water-wheels, 1800 heads of stamps, 319 Hungarian mills, 400 lines of strakes, 58 incline tables (*gold lutte*), with a proportionate number of vanning apparatuses (*Scheidtrog*). The classification is performed in the old establishments in a set of launders, but in the more modern and larger works in classifiers, of which there are 16 now in use.

In the old reduction works also the separation and concentration of the metals is performed on flat buddles, and on 206 shaking-tables with head blows. In the new establishments of improved construction this is performed on about 16 side-blow percussion tables and two rotating buddles, upon which the slimes are worked. The whole of the ores here described are stamped in the same manner, the only difference being that heavier heads are used for hard quartz lead ores than for the soft mundic ores.

Stamps Battery.—The stamps used for crushing the ores consist of the following parts:—

1. The stamps coffer, in which the ore is stamped with water.
2. The lifters, with the heads attached.
3. The stamps-axle, with the transmission-wheels from the water-wheel, or motor.

The stamps coffers are constructed of oak, and consist of longitudinal and transverse timbers securely bolted together, and forming a parallelopiped, 9 in. in width and 3 ft. 3 in. in depth, inside measurement, its length being dependent on the number of coffers in one battery, generally from three to five.

This parallelopiped is divided into spaces equal to the length of each coffer, which, when three heads are forming one coffer, is from 23 to 26 in. in length; and when, as is sometimes the case, five heads are used, from 37 to 42 in.; the minimum dimensions being when light stamps for mundic ores are used, and the maximum ones for heavy heads. The bottom is formed by stamping in dry quartz to a depth of about 2 feet, thus leaving the bottom upon which the material is stamped about 15 inches below the point of discharge. Along the front of the coffers is placed the launder which receives the stamped stuff; between this and the coffer is a sliding board, fixed in such a way that a vertical passage or canal, from ¼ to ½ in. in width, and extending the length of the coffer, is left in communication with the interior of the coffer box, through which the stuff flows to the launder as it is stamped. The flow of the water through this passage is regular and uninterrupted; the agitated or disturbed state of the water in the coffer box not affecting it, as might at first be supposed. The degree of fineness to which the stuff is stamped is dependent on the quanity of water flowing through the coffers, and also on the depth of the coffer bottom from the point of discharge, both which can be regulated at pleasure; the latter by raising the sliding board in front and allowing a little quartz to accumulate in the bottom, thus raising it; or, to deepen it, stamping a portion of the quartz off the bottom, and then lowering the board.

The stamp consists of the head, the lifter, and the tongue. The lifter is of wood, and is from 12 to 14 feet long, and to the lower end is fastened the cast-iron head, weighing from 109 to 138 lbs. About the centre of the lifter is a slot hole 2 in. wide, and from 10 to 12 in. long; in this is fixed the tongue, fastened in with wedges—the hole is made long, so that the tongue can be raised or lowered at pleasure, and thus alter the height of fall of the stamp, which is generally about 9 in. The lifters work in two guides, fixed one about 3½ ft. the other about 10 ft. above the coffer launder. A heavy stamp, including the lifter and tongue, weighs about 370 lbs., and a light one, used for mundic ores, about 247 lbs. The centre stamp-head in each coffer communicates with a lever, which actuates a self-acting feeding pass, in such a manner that as soon as the stamp-head is working the least too low down, it strikes the lever, and jerks in a fresh supply of quartz, until the head is raised to its normal level. The pass consists of a box with inclined sides—the bottom being at an angle of about 15° to the horizon—mounted upon two legs or supports turning in bearing at their lower ends. By this arrangement, as soon as stuff is wanted in the coffer, the stamp in falling strikes the lever, and moves the feeder back a small distance, and as soon as the stamp is again lifted it falls forward by its own weight against the coffer, thus throwing some of the quartz contained in it out, falling thence under the stamp.

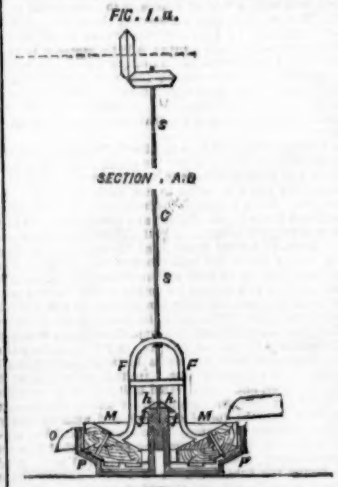
The stamps-axle is of wood, 20 inches in diameter, and having four cams to each head. The axle makes 15 revolutions per minute, thus each head makes 60 blows. The power is transmitted to the axle from the water-wheel, through cog-wheels placed above its axle, for the purpose of raising the coffers as high as possible, to get sufficient fall for the several dressing or cleaning processes the ores afterwards undergo. These stamps require comparatively little water, about 0·3 cubic feet=1·8 gallons per head per minute being required. Every cubic foot of water passing through the stamps carries with it, from a heavy head, from 2½ to 3¼ lbs. of sand, and from a light head from 1¾ to 2½ lbs. The average duty, calculated through one year, was for every 24 hours' working, for a heavy head, 988 lbs., and for a light head 679 lbs. Both kinds of ore are stamped in the same manner, but the succeeding treatment of the argentiferous differs somewhat from that employed for the auriferous ores. I will now proceed to an abstract of the separate processes through which the ores pass, after which I will describe the several machines, their construction, and uses in detail.

1. Treatment of Gold Ores.—The auriferous ores are stamped with water, and flow thence through two rows of Hungarian gold mills, and afterwards over a short line of strakes. The stuff, after passing the strakes, was formerly—and is even yet in our oldest establishments—run through a series of four troughs or launders, each series increasing in width, and thus, through decreasing the rapidity of the flow of water, depositing the stamped ores in four different sizes or classes, each of which are again mixed with water, and reconcentrated over flat buddles, or shaking-tables, with head blows, the inclination of each buddle varying according to the size of the stuff acted upon. The material is now divided into three classes—heads, middles, and tailings or waste, the two former of which are agin concentrated, and the result is a highly concentrated lead or mundic ore, containing the remainder of the gold not caught in the mills. It is now passed over a steeply inclined launder or *lutte*, having diagonal saw-cuts on its surface; this reduces it to a very small quantity, from which the gold is obtained by vanning and amalgamation. The only gold now not extracted is that composed of very minute particles, and more or less overcoated with sulphurets of other metals, especially that of silver; this is ultimately obtained by the smelting process which the lead and mundic undergoes. This process of treating poor ores being slow, and depending largely upon the ability and attention of the workmen employed, our principal mining engineers devoted a deal of attention to the subject. It is unnecessary here to describe the numerous improvements step by step; suffice it to say that the ultimatum now arrived at was achieved by the invention and introduction, by Mr. P. Rittinger, of the classifiers, side-blow percussion-tables, and revolving buddles, as at present in use. By this manipulation the stamped stuff, as it flows from the strakes, is received in a row of four classifiers; from these it is conducted over percussion-tables, and sometimes the contents of the two last and finest classifiers are fed on to a revolving buddle, the result from each of which is a perfectly clean product at one operation. This treatment is a very great improvement upon the old method, as the machinery, being entirely self-acting and continuous, a great saving is effected in the amount of manual labour, as well as from the fact of its being, to a great extent, independent of the skill of the workmen employed. The extraction of the gold from the concentrated lead and mundic, of course, remains the same as before described.

2. Treatment of Argentiferous Ores.—The only difference in the treatment of these from the former ones consists in the absence of the gold mills and strakes, these not being required. This process is equally applicable for tin, copper, lead, &c.—in fact, all kinds of metalliferous ore requiring fine stamping may be treated in this manner with complete success, as a very small amount of labour and supervision will ensure a perfectly clean result.

Hungarian Gold Mills.—These are of very simple construction, and will be easily understood by the accompanying sketch:—

FIG. 1. a.



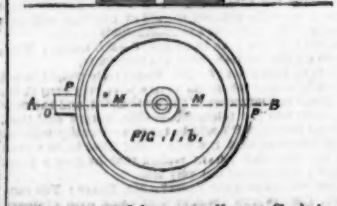


FIG. 1. b.

P, is the pan; M, the muller rotating therein, motion being given to it by the vertical shaft, S, running in the footstep, *f*, above which is a small cover, *h*, for protecting the bearing from any sand or water. The diameter of the pan is 2 ft. at the top and 18 in. at the bottom by 6½ in. deep, and when the requisite charge of mercury is put in the bottom is covered to a depth of half an inch.

The muller is made of wood, the outside being turned parallel to the inside of the pan, but from 1 to 1½ in. less in diameter, thus leaving a space of from ¼ to ½ of an inch all round. The inside of the muller is bored out conical, and has a 5-in. hole through its centre for the stuff to flow through. On the bottom and sides of the mullers are fixed from 16 to 20 radial knives or scrapers, the bottom ones to keep the surface of the mercury clean, which they are sufficiently near to, without actually touching, to effect, and the side ones to prevent any chance of sand depositing before flowing out at the spout, or outlet, O. The vertical shaft, S, is in two parts, connected by a coupling at C; it is also screwed on a portion of its length, and has a set nut above and below the boss of the brackets, F, which carries the mullers. This is for the purpose of setting the mullers exactly to the right height, this being a very important point. The coupling is for disconnecting the lower end of the shaft, and thus enabling the muller to be lifted out of the pan, for the purpose of taking out the mercury. By this arrangement, when the muller is replaced it is exactly true as originally set, thus—through the set nuts having remained untouched—its continued accuracy is quite independent of the man or boy attending them. At Schemnitz the mercury is taken out of the pans every four weeks, the contents of each being squeezed separately through linen bags, the result being soft amalgam; this is again squeezed through linen rags in contact with hot water, till it is again reduced from 30 to 35 per cent. in weight, the result now being hard amalgam. This hard amalgam is made up into small balls of from 4 to 4½ ozs each, which are bound up in fine linen, and are now ready for retorting.

Our experience here has proved to us that the mercury, after being freed from fast amalgam by squeezing, still contains about 12½ dwts. of gold per cwt. of mercury; if required this can be nearly all extracted by distillation. The quantity the mercury is then saturated with ranges from 13 to 17 grs. per cwt. The stamped stuff now as it leaves the lower row of gold mills is freed from its clean, or free gold, as it is termed, and is conducted by launders over strakes covered with a coarse description of linen, on which is caught a small quantity of lead or mundic ores containing a little gold, which has not been caught in the pans through being over coated with sulphurets, as also a little mercury which escapes from the pans.

The linen cloths on these strakes should be washed every hour or so. They will then collect from 2 to 3 per cent. of the total quantity of ore stamped. The strake boards are—according to the ores treated—from 6 to 12 ft. long, 13 to 18 inch wide, with a fall of from 1 to 1½ in. per foot run. The stuff collected by these strakes undergoes a second concentration, by washing it on an inclined plane, called the *gold lutte*. This may be described as a launder, having a number of saw cuts or slots on its surface, from 10 to 12 ft. long, 16 to 22 in. wide, with a fall of from 3 to 3½ inches per foot, and having a series of collecting troughs attached. At the head of this *lutte* is a box, in which some of the stuff from the strakes is mixed with water by an agitator, and then flows over the incline, being at the same time continuously swept backwards with a broom, until all is washed away, except the small particles caught in the diagonal slots; this is then swept down into a receiving trough, and is now reduced to so small a bulk, and of a character rich enough to admit of the gold being extracted by vanning and amalgamation. The amalgamation of this gold is performed by hand, in a cast-iron mortar, and the amalgam being squeezed out is formed into balls, in exactly the same manner as that from the gold mills before mentioned. Of the quantity of gold obtained by this process from 70 to 75 per cent. is caught in the gold mills, and from 25 to 30 per cent. on the strakes and percussion tables, to be hereafter described.

The hard amalgam balls before mentioned, consist of about two-thirds mercury, which is recovered by distillation. This is performed in the following manner:—The balls are placed upon a series of trays, ranged one above the other upon an upright standard, the whole being placed in a retort securely luted, heat is applied, and the mercury passing over in vapour is discharged through the neck of the retort into a condenser, where it is condensed to its original fluid state. The balls are then taken out and cupelled in the usual way. The total loss of mercury by this treatment has been proved by long experience to be only from ¼ oz. to a fraction over ½ oz. per ton of stamped stuff; the larger amount being for treating heavy lead ores, and the smaller for light mundic ores. The stamped stuff flowing from the strakes before mentioned is now conducted through the classifier, which separates the stuff into four different sizes or classes, which may be designated as coarse, middle, fine, and slimes. These classifiers, as constructed and arranged by Mr. Rittinger, consists of four inverted pyramidal boxes over and through which the stuff flows, each of them increasing in width and length, so that the water carrying the sand assumes a velocity in proportion to its quantity, this velocity decreasing over each classifier, consequent upon the increased surface over which it flows. The first is, of course, the narrowest and shortest, and has, therefore, the coarsest and heaviest particles only deposited in it; the next having an increased area, the flow of water is not so strong; and the next size, or middles, is deposited therein; and so on to the last, or fourth, in which is deposited only the slimes. The waste water flowing away from the surface of this classifier is found to be almost entirely free from mineral.

FIG. 2. a. SECTION

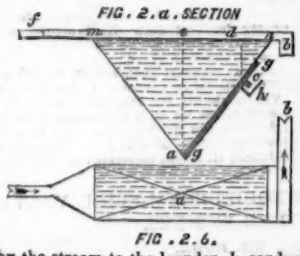


FIG. 2. b.

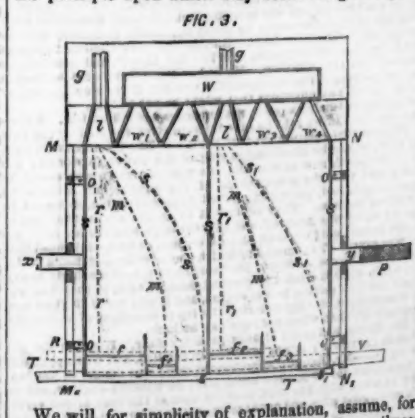
The accompanying sketch represents a classifier of this description, Fig. 2, *a*, being a sectional elevation, and Fig. 2, *b*, a plan, the ends and sides inclining downwards to the point, *a*. The water carrying the sand flows through the launder, *f*, over the classifier to the discharge point at *a*, the velocity of flow, of course, according with the superficial area of the classifier. During its passage the particles of sand and metal sink, which are too heavy to be carried by the stream to the launder, *b*, conducting it to the next classifier, which receives the still finer sand. Care must be taken in the construction of these classifiers that the sides forming the pyramids be neither too steep nor too flat; if too flat, the sand is apt to settle until a quantity has accumulated, when it would suddenly sink and choke the discharge-pipe, *g*; and if too steep, the classifiers would become of inconveniently large dimensions. A gradient of 50° to the horizon is found to be about the most suitable. The sand settled down is allowed, with a proportionate quantity of water, to escape through the pipe, *g*, connected at *a*, and is discharged at *c*, through a mouthpiece, into the saddle-back launder, *h*, which conducts it either to the percussion-tables or the rotating buddles, as the case may be. In arranging these classifiers, care should be taken that sufficient fall be given from the first to the fourth and last, to admit of working without interruption from deposited sand. This can be accomplished by a judicious arrangement of the classifiers, on account of their different heights, and still keep all the percussion-tables on one level. The length and width of the first classifier is entirely governed by the quantity and size of the stuff purposed to be passed through it, and the following ones are, of course, in proportion. Perfect classification entirely depends upon a due observance of these facts. By using the pipe, *g*, the following advantages are obtained:—1. The height of fall from the classifier to the percussion-table is reduced from *a e* to *d c*.—2. The pressure of the water at *c* being so much less than at *a*, the mouthpiece can be proportionately larger, so that the chances of choking are thereby greatly diminished. Each classifier, according to its capacity, supplies one, two, or three percussion-tables or rotating buddles, and upon the quantity of stuff being treated depends the whole arrangement.

The following table shows the percentage of sand deposited in each classifier, as also the quantity of water and sand contained therein flowing from the mouth-pieces to the percussion table:—

	Per centage of mineral deposited.	Cub. ft. of water flowing through each mouth-piece.	Weight of sand to 1 cub. ft. of water.
First classifier	40	0·416	22 lbs.
Second ditto	22	0·277	18·6
Third ditto	20	0·208	22
Fourth ditto	12	0·166	16·5

Mr. P. Rittinger's Percussion Tables.—Each classifier, as before explained, supplies one or more percussion-tables with stuff. Before I describe the construction of the percussion-tables, it is necessary to describe the principle upon which they work.—Fig. 3 represents a plan of two tables in one frame, divided by the strip, S. These tables are suspended by rods from the points, *l*, in such a manner that they represent an inclined plane, the upper or higher end being at M N and the lower end being at M, N. The sand and water is, after leaving the classifier, supplied to tables at *l* and *l*, the other feeding places, W_1, W_2, and W_3, W_4, being for the supply of water only, which is fed from a tank, W.

FIG. 3.



We will, for simplicity of explanation, assume, for the time, that the suspended tables are fixtures. It will now be easily seen that the mineral suspended in the water fed on at the head will flow directly down the incline to the bottom of the table. It will also, upon consideration, be apparent that the stream of water will carry the lighter minerals down considerably faster than the heavy particles of metal, precisely the same as is done on a flat buddle, the quartz, limestone, &c., offering far less opposition to the stream of water than metallic particles of a greater specific gravity

rity. These conditions being now understood, it is necessary to explain that the tables are, as before stated, suspended from four points, and are free to oscillate in one direction—*i.e.*, at right angles, to the direction of their inclination. This oscilation is produced by a cam-wheel acting upon the end of the beam, *y*, upon which the table is mounted, the cam pushing it in one direction, and a spring acting on the end at *x*, bringing it back again with a sharp blow against the solid block, *P*, when the cam again catches it, and a quick succession of blows is the result. It will thus be seen that the ores on the table are subjected to two forces, the one being the stream of water tending to wash the particles down to the bottom of the table, the other tending to bring them over to the two ridges, S and S, this being nothing more than the impetus each separate particle has acquired from the motion given to it by the table.

The particles of ore being subjected to these two forces combined have this resultant—the heavier, or metallic particles, resisting the action of the water for a much longer time, and from the fact of their being influenced to a greater extent, on account of their superior weight, by the blows of the table, they describe in their descent a curvilinear line, *ss* and *s,s*, and leave the table at *s* and *s*, where they are received in a launder beneath. The light minerals suspended in the water reaching the bottom of the table much quicker, and being less acted upon by the side blows of the table, describe the shorted line, *rr* and *r,r*, and leave the table almost in a straight line from *l* and *l*, where it is fed on. From this description it will be seen that metals of different specific gravities can be separated the one from the other at one operation.

The commonest form of construction in use is that shown in the sketch—two tables in one frame mounted on one beam. Three tables may be constructed together, but on account of the great increase of weight such form is objectionable. The tables are mounted upon a rectangular frame, to which also is fixed the transverse beam which receives the blows; these are firmly secured together, to enable them to stand the continual strokes against the stop-block, *P*, without deterioration. The surface of the tables are planed as smooth as possible, and are framed in, and divided by the strips, S, each table being nbout 8 feet long by 4 feet wide. At the lower end of the table are openings, $f f_1 f_2 f_3$, under which and under the end of the tables are three parallel launders, which receive the stuff from the respective divisions of the table; the launder, T T, receiving the clean metal, the launder, V, receiving a mixture of metals and waste, which is returned to the classifier by a bucket-wheel or elevator, while the launder, R, receives the waste, which is allowed to flow away to the river.

The tables are suspended from four pillars by iron rods, on one end of each being a screwed swivel, which admits of the inclination being altered at pleasure, the tables, as before stated, being free to oscillate in one direction only. Motion is given to the table by a cam-wheel acting upon a lever connected with the tables by a rod, which can be shortened or lengthened by the aid of a set screw, thus regulating the length of the stroke at pleasure. The tank, W, supplies water to the tables, over the feeding-boards, w_1 w_2 and w_3 w_4, each having a tap or other contrivance to regulate the supply. The feeding-boards, *l* and *l*, are for supplying the mineral suspended in water to the tables; this is conducted through saddle-back launders, *g g*, as shown in sketch, from the classifiers. To obtain successful results from these tables, care must be taken that the surface of the tables are perfectly smooth, and that, in the direction of the blows, they are horizontal. The stamped stuff must not flow on through too wide a feeding-board, about 1 foot being sufficient, as the remainder of the table is required for cleaning surface, whereon the water can exercise its influence.

The length of stroke and number of blows vary according to the stuff treated, the coarser the materiel the longer and stronger (and necessarily the lesser numbers of) blows, and *vice versa* with finer stuff. The quantity of water containing mineral in suspension to be fed on a single table, is of coarse stuff 0·2 of a cubic foot=1·2 gallons, containing 19¼ lbs. of sand per cubic foot; and of slimes 0·12 of a cubic foot=0·72 gallons, containing 5 lbs. of sand per cubic foot in suspension. The quantity of clean water requisite for washing this is 0·4 of a cubic foot for rough stuff, and for slimes 0·24 of a cubic foot per minute. The superiority of these tables over other modes of dressing consists in the fact of their being continuous in their working, a clean product, also, being obtained at the first operation. A great saving of labour is also effected on account of their simplicity of action, as, after being once set properly to work, a boy can attend to several, thereby entirely dispensing with experienced dressers.

Mr. Rittinger's Rotating Buddle.—The contents of the third and fourth classifiers, consisting of fine and slimes, can be concentrated over one of these buddles instead of a side-blow percussion-table, as they are quite as well adapted for the purpose.

[To be concluded in next week's Journal.]

RECENT AMERICAN PATENTS.

Crushing Ore.—Alexander W. Hall, of New York, claims enclosing the crushing-wheels of a machine for crushing and pulverising ore or other materials by an air-tight cover, so combined with the pan in which the said wheels work as to form therewith an air-tight chamber, in which the crushed or pulverised material is subjected to the action of a blast or blasts of air.

Puddling Furnace.—Hugh M'Donald, of Pittsburgh, Pa., claims the use of iron ore in its raw or unmelted state, previously ground fine, and mixed into a thick paste or dough with water, as a fixing for puddling or boiling furnaces.

Iron and Steel.—James Henderson, of Brooklyn, N.Y., claims mixing manganese, or the equivalent thereof, with the ore or ores charged in the blast-furnace for smelting, in combination with and to produce crude molten iron, to be directly converted by the pneumatic process.

Carburetting Air.—Erasmus Allington Pond, of Rutland, Vt., claims the method of charging atmospheric air with the vapour of hydro-carbon fluids, by the discharging the air through contracted openings into the mass of fluids; also, of charging atmospheric air with the vapour of hydro-carbon fluids, by dividing the column of air, and discharging the same into the liquid in small streams.

Cupola Furnaces.—Annes A. Lincoln, of Norton, Mass., claims the arrangement of the steam-jet and air or blast apparatus, so as to cause the commingled currents of vapour and air to enter the furnace at a point above the grate or fuel base without first going through it, meaning specially to claim a cupola furnace as made with tuyeres and steam-jets combined together and arranged with respect to its hearth.

Ore Crushers.—A. W. Hall, of New York, claims a stamping-mill having an air-tight battery, into which air is forced or drawn through one or more inlets, and from which the pulverised material is carried with the escaping air to a suitable receiver.

Rolling Iron and Steel.—D. Hall, Pittsburgh, claims the use in one set of housing of two pairs of rolls arranged with their axles all in the same vertical plane, the upper pair being geared together so as to pass the iron or steel through between them in one direction, and the lower pair being geared together, so as to pass the iron or steel through between them in the opposite direction, for the purpose of enabling a continuous strip or band of metal to be passed backwards and forwards between the rolls, and thus operated upon at several points at the same time, and for other purposes; also the combination of the guide roller, and adjustable guide, and curved guide box, with one or more pairs of rolls.

Incrustation of Steam-Bolers.—A. F. Porter, Philadelphia, claims the apparatus consisting of a conductor armed at one end with a series of points, or their equivalents, and connected at the other extremity with the shell of the boiler, the whole being constructed within it at some intermediate point by an insulated attachment.

Coal and its Products in New South Wales.—It seems probable that our supply of illuminating oil will be augmented by shipments from New South Wales, the apparatus and plant for the manufacture of kero-sene oil at the new Hartley Kerosene Mine having been nearly completed. Mr. E. D. Nicholls, of the Sydney Iron Company, has had the entire charge of erecting the buildings, in the construction of which iron is the only material used. The first bank of retorts, as well as the large stills, are long ere this finished, and it was fully expected that the works would be in full operation by Oct. 1. The works will for the present be capable of manufacturing 10,000 gallons of oil weekly, which quantity will be gradually increased. The enterprise presents very encouraging prospects, crude petroleum oil from Pennsylvania being quoted in the English market at 20*l.* per tun. The mineral seems likely to find an extensive market in the East, orders having already been received from Singapore for a quantity to be sent on there for the purpose of improving the gas. There are gasworks at Bombay, Hong Kong, Calcutta, Singapore, Shanghae, Madras, Java, Cape Town, and other places where it is anticipated this mineral will be used. The Bathurst papers report that a trial of the mineral for gas, without the addition of any other material, was recently made in that town, under the superintendence of Mr. J. C. Stanger, and that it proved a great success, it being stated that 30,000 cubic feet of gas to the ton of mineral were obtained. This was an extraordinary result, the ordinary coal of the colony not giving more than 11,000 feet. Since the commencement of operations at the Hartley Mine, about 250 tons have been delivered to the gas companies in New South Wales and the adjacent colonies. As the driving extends into the hill the depth of the seam increases, and the quality of the mineral has somewhat improved. The property is worked by a company with a capital of 30,000*l.*, of which 25,000*l.* has been paid-up, an amount which it is considered will be ample for its purposes, and to place it in a profitable and satisfactory position.

Petroleum as Fuel.—At well No. 37 they were burning crude oil for fuel, and used two and a half to three barrels per day. As oil is worth about $2 nett, the cost is $5 to $6 per day. Wood or coal would cost two or three times as much. A pan is placed on the ash-pit containing a layer of broken brick, or other porous earthy material. A pipe with an elbow on the end, to turn the mouth up, leads from a reservoir, and delivers the oil slowly over the middle of the pan, in suitable quantities, regulated by a cock.—*Scientific American.*

BIRTH AND GROWTH OF THE IRON TRADE—No. III.

BY JAMES ROBERTSON, ESQ.

[Read at the meeting of the London Association of Foremen Engineers.]

To the architects and civil engineers of Great Britain much is due for the development of the iron trade, as to them the application of iron to bridges owes its existence, and their example was speedily followed by their continental brethren. The first cast-iron bridge ever erected was that over the Severn, about two miles below Colebrookdale, in Shropshire. Bridge building was studied in England from a very early date, and great triumphs were achieved in this department of science, triumphs which outshone the proudest monuments of ancient architecture; but it was reserved to us to substitute iron for stone, to raise, by the means of fire and minerals, structures to all appearance imperishable. The metal bridge above alluded to was erected in 1777; its chord is 100 ft., and its height 45. The second cast-iron bridge was designed by the celebrated Thomas Paine, author of the "Rights of Man," and was intended to be taken to America, but the contractor having failed in his payments its materials went to the construction of that beautiful bridge over the Wear, at Bishopswearmouth, Sunderland; the chord of the arch is 240 ft. long, and the Southwark bridge over the Thames is at present the finest cast-iron bridge in the world. Paris has 27 bridges over the Seine; they are all free. We have eight between Battersea Park and London-bridge inclusive, and at five of them tolls are demanded. The weight of the iron in Southwark-bridge is about 5000 tons. These and other public works, which cannot be completed without the liberal employment of iron, were becoming more numerous; the wonderful network of noble canals which interlace the kingdom gave an impetus to the trade. Our canals form one of the most remarkable features of Great Britain. The Caledonian Canal, uniting a chain of natural lakes, though the most magnificent of its kind, is by no means the most important; it was designed by Telford, whose ashes rest in Westminster Abbey, where have been lately laid beside them those of his gifted and once humble admirer, Stephenson. It is true we were a century behind the French in forming canals upon a grand scale. The first considerable work of this description was the Sankey Canal, for which the Act was passed in 1755; it was 12 miles in length, and whilst this work was in progress the Duke of Bridgewater obtained an Act for making his canal to convey coals from his estate to Manchester; he devoted his time and fortune to the completion of his great work, restricted his personal expenditure to 400*l.* a year, and it is said shortened his days by incessant application to his scheme; he died at the age of 55, having lived 14 years after the completion of his project, and left behind him a stupendous monument of his energy and perseverance, associating his memory with the wealth and prosperity of England. The works were projected by the celebrated engineer, James Brindley, and testify to his genius and skill. There are now over 120 canals in Great Britain and Ireland, many of them having branches, and their total length amounts to 3700 miles. But the first canals in Europe were constructed in Italy; they were afterwards far surpassed in extent in Holland, which possesses such great physical advantages for this mode of communication. "It was," says M. Dupin, "under the administration of Lord Chatham that we beheld the commencement of these great interior works, useful to commerce, which are now the admiration of every foreigner. Up to 1756 England had not a single line of artificial navigation, and she possessed for communication by land only a small number of roads, injudiciously made and ill kept. Suddenly an individual conceives the idea to profit by the general impulse which industry has received, by cutting a canal to carry to Manchester the produce of his mines. Shortly afterwards, a town which thrives, and of which the exuberant wealth seeks everywhere productive outlets (Liverpool), aspires to still higher designs. She is the first to form and realise the project of opening a navigable channel betwixt the Irish Sea and the German Ocean. Other channels, even more extended, are established by degrees in both ends of the island, and thus, within the short space of half a century, a line of canals is formed both for great and small navigation, for the purpose of uniting opposite seas, basins separated by numberless chains of hills, opulent ports, industrious towns, fertile plains, and inexhaustible mines."

But some may ask, What has this to do with the development of the iron trade? I answer much, every way. The sciences are sisters, and go hand in hand; a nation's advancement is gradual, step by step; civilisation carries with it a people's material greatness; the internal progress of a kingdom is the best guarantee of the extension of her greatness beyond her own limits; and her foreign commerce is the best evidence that her home wants are supplied. Besides, the internal development of our public works has increased enormously; the demand for the metal of which I treat, and the extensive use and production of that metal, have been always held as an evidence of the progress of civilisation. Kings may command, despots may decree, and slaves may tremble, but the terrors of the despot and the drudgery of the slave could never have achieved what the free and intelligent population of these islands have accomplished, or raised the iron trade to its present high prominence. To the rapid advancement and unexampled greatness of the colonial possessions and dependencies of Great Britain, between the latter quarter of the last and the first of the present century, much of the iron trade's progress is attributable; and although the population at that time was increasing rapidly at home, emigration to the United States of America and Canada was considerable, although much below what it has been within the last ten years; and the progress of the colonies themselves has been such as to excite the most pleasing anticipations for the future. To Canada alone the emigration has amounted to 50,000 a year for the 18 years preceding 1848, and an equally great number left these shores for the United States during the same period. Of all nations, in ancient or modern times, Great Britain is the greatest coloniser, and a degree of prosperity and blessing has attended her offshoots, such as place them inferior only to the mother country, and certainly above some of the misgoverned old monarchies of Europe. Previous to the breaking out of the continental wars the colonies of Spain were the richest and most extensive of any power in the world, but now— "Oh! how art thou fallen,

Lucifer, son of the morning!"

Cuba, Porto Rico, and the Phillipine Isles are all that remain to Spain of her once vast colonial empire. The shipping employed in conveying the products of Canada to this country, and ours to her, amounted in 1849 to 1,100,000 tons, all British. Great quantities of iron are sent to Canada, principally from Scotland. Canada is rich in minerals, and awaits the development of her wealth.

In the West Indies we possess Jamaica, the largest and most valuable of our insular possessions, Barbadoes, St. Lucia, Antigua, Granada, Trinidad, with some other islands, exclusive of Demerara and Berbice. These colonies take our machinery and iron, and our Australian colonies are rapidly increasing their demand for these productions.

The reason of our colonial greatness lies in the character, ability, and industry of the emigrants who leave the land of their birth to seek new homes and fortunes in other climes, those hardy sons of toil who know no other means of existence but honest labour, who taste no repast which has not been sweetened with the consciousness of exertion, and go forth with a stubborn determination to succeed in the land of their adoption. They leave this country in the dawn of the maturity of their physical powers; they tear themselves away from the endearing associations of early life; from the picturesque though humble cottage, with all its fond endearments; from the village church, with moss-grown tower and climbing ivy; from the sound of the Sabbath bell, whose familiar tone may be heard by them no more; from the hallowed tombs of their ancestors, dotted in the churchyard round the rustic porch; from scenes of their early loves, their boyish strifes and triumphs; from that humble seminary—

"Beside yon straggling fence, that skirts the way
With blossoms furzed unprofitably gay,
Where in his noisy mansion, skilled to rule,
The village master taught his little school,"

To a land of prairie and of wild, without memories of past, without friends or antagonists save the primeval stubborness of Nature, but filled with hopes of the future, backed by the dim possibility that he may one day return to tell his few surviving friends the story of his struggles and success.

The emigrant has arrived at the seaport town. The vessel is about to sail; her living freight has gathered on the deck to take the farewell look at the streets, quays, and the crowd which has gathered to witness her departure. There are many glistening eyes on board that ship; there are many beating hearts, which struggle manfully with their emotions. The hawsers are thrown off one by one, but ere the last rope, which is the last and only tie between the emigrant and his native land, is let go, the crew gather aft, and three cheers are given in token of adieu; they are returned from the pier, and a strange and deathlike thrill pervades all beholders, and the handkerchiefs are waved till the receding faces can be no longer seen, and the groups of gazers disperse sadly and slowly to their homes. But the emigrant has put his hand to the plough, and will not retract. It is such men who have founded the colonial greatness—that colonial greatness which has contributed so much to the development of the iron trade.

To protect and foster a colonial empire so vast—to guard and convoy our merchant fleets in safety across the seas in the midst of a terrible war which was convulsing Europe—to maintain the prestige of the flag of England, which had for ages braved the battle and the breeze—a Royal Navy arose which was more than equal to its duties. It was not enough that the navy should be able to protect our commerce on the seas and colonists abroad, it was also indispensable that it should be able to cope with the navies of France and Spain, Russia and Denmark united; and although iron shipbuilding, and the application of steam to navigation had not been invented, yet iron was extensively used at the time to which I allude (the beginning of the present century), as it always must be in the construction of wooden vessels. In 1793, when the French revolution broke out, the Royal Navy consisted of 135 ships of the line, and 133 frigates and other vessels: giving a total of 268 ships of war. It is, therefore, manifest that between the years 1793 and 1812 the navy was increased by the astonishing number of 716 ships, or nearly three times its strength at the commencement of the war, and whilst the navy was being augmented the population of Great Britain was not diminishing.

The adoption of iron chain cables by this vast and increasing Royal and Mercantile Navy was another spur to the iron trade. Clumsy cables of hemp had been used up till 1808, when it was with difficulty it could be imported, and then chain cables began to be generally adopted. Many a good ship, which otherwise would have ridden out the storm, went to pieces on a lee shore, like the ill-fated *Royal Charter*, not because her chain cables were inferior in tensile strength, but because she had a hempen cable, which, after a short time chafing against the rocks or coral reef, snapped asunder, leaving the vessel helpless at the mercy of the pitiless storm. M. Bougainville, the French discoverer, found this to his sad experience, as he states in "Voyage Autour du Monde," published so far back as 1771, he lost six anchors in nine days from the chafing of the cables against the rocks, and their consequent parting, and at last narrowly escaped shipwreck. I shall translate what he says—"If we had been provided with some chains of iron this would have been avoided; this is a precaution which no navigator bound on a voyage like mine should ever forget." Honest and valuable as this advice was, more than forty years elapsed before it was adopted. The first to obtain a patent for a chain cable was Mr. Slater, a surgeon in the navy. Many improvements have taken place in this branch of manufacture, and now a shipmaster would no more think of leaving port without chain cables, even if Lloyds permitted him to do so, than he would think of leaving his anchors at home (like the Dutchman).

I now approach the chief agent in the development of the iron trade—the Steam Engine—that wondrous machine which has done so much for our manufactures—which has multiplied almost indefinitely the means of communicating knowledge, which has aided and advanced our literature, hastened on our civilisation, and contributed so vastly to our material comfort. This modern Hercules, born of the ingenious brain, and reared by the skilful hand of the mechanic, obeys his will and labours on without complaint. He asks no recompense for years of toil, however hard and difficult the task. He asks no gaudy robe to deck his powerful limbs, to shield them from the summer's heat or winter's piercing cold, his drink is water and his food is flame, and the object of his employment the welfare of mankind. To you whose vocations make you conversant with the principles and construction of the steam-engine, it would be out of place in me to describe either, although the subject is fertile and enticing. I shall, therefore, content myself with some remarks upon its origin, and which, although they cannot be new to you, may recall something you may have forgotten long ago, and bring it back to your memories with more than the charm of novelty, as the songs and ballads of our youth come bounding in at Recollection's gate, when heard accidentally from a stranger's voice, or the remembrance of a dream long past comes to life by the realisation of some of its incidents. The invention of the steam-engine, then, has been universally ascribed to the Marquis of Worcester: he published an account of his invention about the middle of the 17th century. The French, our rivals in science, as in war, ascribed the invention of it to Papin about the latter end of the same century, and although there can be little doubt that steam was employed as a motive power more than thirty years before the Marquis of Worcester's invention, Papin, or the French, can have no real claim to the discovery, as they claim it so long after the publication of the invention by the marquis. It is not authenticated that the marquis ever had an engine actually at work, for the first of which we have any record was made by Capt. Savery, an Englishman, who obtained a patent for it in 1698. Savery's engine was employed to raise water, the first object to which steam-engines were for sometime applied, and his engine worked by the expansion and condensation of the steam in a rude way. Afterwards the steam-engine received improvements from Newcomen, Beighton, Blakey, Brindley (mentioned before), and others, but still its organisation was far from perfection, and its construction was rude and cumorous. It was reserved for one man, by his constructive and inventive genius, to acquire a deathless fame by its completion and perfection—that man was James Watt. Hallowed be his dust, his memory revered; his greatness has been related by the mightiest spirits of the age—the engineer, the philosopher, the scholar, are amicable rivals in paying homage to his great attainments; and in approaching a name so great, I tread with reverend awe; for it is to him the iron trade is a debtor far beyond its power of disbursement, and it is to him it owes a debt, even the interest of which it can never repay.

James Watt was born at Greenock, in January, 1736, and it is said that his family was remarkable for mathematical talent, his grandfather and uncle having been mathematical teachers; his father was a merchant, and for many years one of the magistrates of that town, which has since attained great commercial importance, and is pre-eminent for its manufacture of the machinery which Watt's inventions brought to light. The extreme delicacy of his constitution when a child prevented his deriving much benefit from the day schools of his native town, but his intellect was fostered at home. Being a sickly child, he sat at the fireside, and was always playing with the lid of the kettle, lifting it on and off, and soiling his clothes and fingers, to the great annoyance of his aunt, who gave him many a sound scolding, and could not understand what the boy meant by such conduct. His early feebleness of frame had a great influence on the intellect and after greatness of the man, for his mind became expanded, and the child began to think before he had learned to play. It was so with Pope, Dr. Johnson, Scott, and Byron. It was then that the studious habits which distinguished his career were planted.

Watt came to London when he was 18, to learn the business of a mathematical instrument maker; he remained 12 months, and made great progress in various branches of mechanical art, and two years after he had returned to Glasgow he was made mathematical instrument maker to the University of that city. Young Watt was now 21 years of age. The Professor of Natural Philosophy employed Watt to repair a model of Newcomen's steam-engine, that he might exhibit it to the students in working order; this was when Watt was 27, and it was the difficulty which he found in supplying this model engine with steam that led him to the threshold of his great discoveries. Watt said in the state in which he found the steam-engine it was no great effort of mind to observe that the quantity of fuel necessary to make it work would for ever prevent its extensive utility, and that the next step in his progress was equally easy—to enquire what was the cause of the great waste of fuel; this at once suggested itself. The cause was apparent—it was the waste of fuel necessary to bring the whole cylinder piston and adjacent parts from the coldness of water to the heat of steam no fewer than from 15 to 20 times a minute. It was then—in one of those happy moments when the divine light of genuis breaks in upon the soul, like forked lightning on a dark December night, illuminating the obscurity with more than mid-day brightness—that the idea of condensing in a vessel apart from, but communicating with, the cylinder broke in upon him, and filled his soul with a new and strange delight.

Newcomen's condensing was produced by throwing a jet of cold water into the cylinder itself, thus creating a great waste of fuel by reduction of the heat; his cylinder was open at the top. Watt had now discovered the cause of the waste of fuel, and by his condenser the steam, after it had performed its function, was got rid of, and the vacuum formed without cooling the cylinder; this was a great stride towards perfection. His next improvement was to close the top of the cylinder and obtain a downward pressure of steam upon the piston, instead of the atmospheric pressure consequent on condensation. This was another great triumph; but he continued his experiments in the University, and carried them to perfection. He discovered, also, parallel motion as applied to working the steam-engine.

Two years after this he entered into partnership with Dr. Roebuck, the originator and founder in a double sense of the Carron Ironworks. Their object was to establish a steam-engine manufactory, but the agreement was never carried out. Dr. Roebuck became involved in embarrassments, and Watt found employment as a civil engineer. He was engaged in the surveys of canals in Scotland, and surveyed part of the Caledonian Canal, between Fort William and Inverness; and not long after this he accepted the invitation of Mr. Boulton, of Soho, near Birmingham, and settled in England. It was not till 1775 that he actually began to manufacture his engines, an extension of the term of his patent having been obtained in that year, so that there were 12 years frittered away before the public became convinced of the value of steam-power. When they did so they began by pilfering Watt's inventions, and for the next 25 years he was harrassed by a host of infringers of his patents, against whom he sought redress in courts of law. The validity of his claims was finally established by the decision of the Court of King's Bench, in 1799. Watt now interested himself with the advancement of science, literature, and the arts; he was a man of great attainments in them all. His intellect was so capacious that he mastered every subject to which he turned his attention. When worried and pestered by the litigation necessary to maintain his rights he studied law, as he took no opinion at second-hand; and we have the authority of Lord Brougham for saying that Watt was a profound and able lawyer. He could converse with Germans in their own language, and point out to them the beauties and defects of their own literature and poets. His memory was like a vice, and held in its iron grasp whatever it acquired. His imagination was fruitful in resources, but the ordinary and most striking characteristic of his mind was invention. His judgment was profound and critical, for he saw nothing of which he did not discover the defects, and suggest their remedy. His taste in works of art was accurate and refined. He even invented a machine for copying sculpture with the utmost accuracy. His society was courted and sought, and even whilst he was mathematical instrument maker to the University of Glasgow the professor of moral philosophy was in the habit of asking the young mechanic for the solution of difficult questions in metaphysics; Watt answered them at once—to him they were as axioms, self-evident propositions. He had thought much, and his learning was, perhaps, as much the result of his own observation on what he found within his own mind as of knowledge from without. When Burns read the first six books of Euclid, during the winter nights, he said, on laying the book aside, "It's all very true, but there's nothing in it I didn't know before." Watt's mind was of this large calibre. Oh! what a source of knowledge lies within ourselves, if we would only turn our penetration to the mine of thought which we possess as the inalienable gift of the great author of our being. If we would but cast the bull's-eye light of observation on the dark corners and recesses of our souls, what lost and hidden treasures should we not find, and of the existence of which we were ignorant! What we read and study is of little moment if there be not pegs in the wardrobe of the soul to hang our gains upon, and wherever you find a man who, without education, has raised himself above his competitors in the great struggle of life, depend upon it he has drawn his intelligence and ability from that fund of knowledge which is within, and which we all possess in common. Watt had no ear for music whatever: indeed, he could not distinguish one note from another, yet he constructed an organ which possessed every mechanical merit, and he overcame the errors which would have resulted from his defective ear by studying Smith's "Harmonics," a work both profound and obscure, but which contained the theory of the beats of imperfect consonance, then little understood. He also made a guitar for Dr. Roebuck's daughter, for which he obtained five guineas. His reading and his studies were always after the hours of labour, as he considered business his first duty. His mechanical skill was admirable; there are some models still extant made by Watt's own hand, which display workmanship of the highest order, and he always knew how to estimate this quality in others. He was fully aware that his great discoveries in the steam-engine were adaptable to conveyance by land, and in 1785 he took out a patent for moving carriages by steam, but he does not appear to have ever used it practically. Watt was the author of a machine for copying letters, and of a system of heating buildings and hot-houses by steam. He discovered the composition of water, after having carefully examined all the experiments made by Waritire, Macquer, and Priestley on the combustion of hydrogen and oxygen gases; he showed that water was formed by the union "of two gases, and their parting with the latent heat which had held them in the elastic and gaseous state, but which being withdrawn by their union left them in a state of liquid or aqueous fluidity." His only son died in 1804, at the age of 27, having given promise of a brilliant career, and abilities like his father's. Watt bore this great trial with the most manly fortitude and devout resignation. Watt was chosen Fellow of the Royal Society of Edinburgh in 1784, and of the Royal Society of London in the year following. The degree of Doctor of Laws was conferred on him by the University of Glasgow, and he was chosen corresponding member, and afterwards one of the eight foreign members of the Royal Institute of France. He died at his country residence, Heathfield, in Staffordshire, on Aug. 25, 1819, in his 84th year, full of gratitude that Divine Providence had so lengthened his years. His remains lie buried in Handsworth Church, near Birmingham, and the greatest work of Chantrey, his monument of Watt, adorns his tomb; it is a twofold monument, for whilst it commemorates the achievements of him whose dust slumbers beneath it, it perpetuates the genius of the sculptor whose chisel made him live again in marble. There is a counterpart of that statue in marble in the Greenock Library; I have known it from my earliest years. Lord Brougham says Watt's conversation was "withal spirited and lively; it was easy and concise, without the least of lecturing formality. His voice was deep and low, and if somewhat monotonous it yet seemed in harmony with the weight and beauty of his discourse, through which, however, there also ran a current of a lighter kind, for he was mirthful, and temperately jocular; nor could anything to greater advantage set off the living anecdotes of men and things with which the graver texture of his thought was interwoven than his sly and quiet humour, both of mind and of countenance, in relating them." Dr. Ure, in speaking of Watt, says his intellectual Alembic had sublimed from every substance its purer essence, and left the grosser parts behind. His vastly capacious memory had retained nothing commonplace; it was replenished with stores of intellectual wealth, well defined and arranged, and it may be doubted if ever there was a mind so well framed, so happily constituted, as that of Watt; his piety was rational, steady, and unobtrusive, his benevolence manifest in every circumstance of his life; he sought always to do good, and was a stranger to malignity and envy. Watt's epitaph was written by Lord Brougham; it runs thus:—

"Not to perpetuate a name, which must endure while the peaceful arts flourish, but to show that mankind have learned to honour those who best deserve their gratitude, the King, his Ministers, and many of the Nobles and Commons of the realm raised this monument to—

James Watt,

Who, directing the force of an original genius early exercised in philosophic research to the improvement of the steam-engine, enlarged the resources of his country, increased the power of many, and rose to an eminent place among the most illustrious followers of science, and the real benefactors of the world. Born at Greenock, 1736; died at Heath Hall, in Staffordshire, 1819."

Such is the summary of his merits on his tomb. I have thus endeavoured to show you how the steam-engine attained its present state of perfection, and to give an outline of the genius and character of him to whose abilities that perfection is attributable, how this great agent in the development of our iron trade and mineral wealth rose from a rude and cumbrous impiement to one of symmetrical beauty, utility, and almost universal application; but in treating of this subject I have been unable to bring it down to the present time, and in drawing my observations to a close I feel as if half had not yet been told, that I have but sighted the shore and cast anchor on a new continent, a new hemisphere, of which much remains to be said, in which there is much to be done—in a word, there still remains the consideration of the marine engine, its adaptation to ocean-going ships and ships of war, their construction of iron, the extensive application of that material to the purposes of navigation, and the triumphs over the elements which the power of man has achieved. There also remains the consideration of our railroads, and the application of iron to this great discovery in transit—the locomotive engine, and the impulse which at home and abroad it has given to the iron trade; and if this subject is to be fully treated the various manufactures of iron and steel which daily issue from the workshops of Birmingham, Sheffield, Manchester, and Glasgow require due notice and respect. In discoursing on the development of the iron trade, from the period mentioned in the outset, I have only been able to reach the year 1820, but the time embraced within these dates is full of great events, political, historical, and scientific, and had the germs of progress not been then sown, there would have been no development to boast of, but, like the proud and penniless noble, whose grandfather had wasted and lost all the hereditary acres, we should have been boasting of our ancient descent, our long line of noble ancestors and illustrious deeds, while nobody but ourselves cared a jot

about either; but the seeds of our greatness were sown between the periods named, and fresh seeds are being sown each year, which lead us to anticipate a future still more glorious in triumph than the past. The resources of the engineer are inexhaustible; his brain is ever fertile, the secrets of Nature are far from having been explored, her productive power is not *effete*, and great discoveries will doubtless yet be made. Men of daring and original genius will arise; those who will look to new discoveries as the recompense of their ability, without trenching on the achievements of a past generation. It has ever been so, and we have the best of authority for believeng that what has been, still will be. The mineral wealth of our country is inexhaustible, and the power of developing it inadequate, now that a liberal policy is being adopted by continental nations, I feel convinced that so soon as necessity indicates that greater activity and new appliances are required they will not be wanting.

In speaking, therefore, of the development of the iron trade, I do so only with reference to the past, with reference to what we have seen and know. As to its future, I need not nor cannot predict; but of this we may feel assured, that backwards it cannot go. Its march is onwards, its power irresistible. When Alexander the Great of Macedon had conquered the East, and subdued what was then considered the whole world, he sat down and wept that there was not another world to conquer, whilst all the time America lay undreamt of and unknown. When Canute the Dane, seated by the waters of the Solent, rebuked the wave and bade it retire as it surged against his royal feet and kingly chair, he knew the rolling wave obeyed no kingly voice save that which "calls the tempest forth and stills the stormy wave;" and the king rebuked his flatterers and followers, teaching them the lesson that the laws of Nature are immutable, that the tide of advancement will not be bridled by an impotent command. So will the engineer progress, in spite of every obstacle, resistless as the ocean's tide; and new discoveries will reward his bold endeavour, till every obstacle subdued, every difficulty overcome, he may wish there still was something more to conquer.

SALES OF COPPER ORES.

COPPER ORES SOLD AT THE CORNWALL TICKETINGS FOR THE QUARTER ENDING SEPTEMBER, 1865.

Mines.	Tons.	Amount.
Devon Great Consols	6239	£28,532 12 0
South Caradon	1779	13,924 6 6
Clifford Amalgamated	3322	13,449 15 0
Wheal Seton	2066	6,604 8 6
Wheal Rose	1003	4,968 7 6
East Caradon	1232	4,928 16 0
West Basset	829	4,407 12 0
Hingston Down	968	3,747 1 6
Wheal Friendship	539	3,668 18 0
Marke Valley	1245	3,652 14 0
East Carn Brea	911	3,483 10 0
Fowey Consols	705	3,317 13 0
Wheal Basset	508	3,301 9 0
Prosper United	1042	3,176 8 0
East Rosewarne	392	3,053 2 6
North Treskerby	635	2,954 16 6
South Crofty	462	2,550 17 0
Phœnix Mines	1017	2,464 2 0
Great Wheal Busy	807	1,989 7 0
New Wheal Martha	1136	1,931 3 6
North Roskear	318	1,833 3 0
West Caradon	375	1,826 6 0
Bedford United	431	1,648 12 6
South Tolgus	410	1,645 9 0
Wheal Margery	552	1,633 3 6
Bampfylde	138	1,569 3 0
Devon and Cornwall	507	1,482 1 6
Halienbeagle	335	1,450 3 6
Okel Tor	549	1,431 10 0
Rosewarne United	155	1,143 4 6
South Frances	213	1,099 11 6
West Wheal Damsel	301	1,038 9 0
East Pool	303	1,010 0 6
New Rosewarne	183	976 10 6
Carn Brea	265	955 18 6
Tolcarne	262	942 11 6
Botallack	112	878 6 6
Great South Tolgus	183	837 0 0
East Russell	246	819 1 6
Great North Downs	195	793 10 6
Craddock Moor	156	763 10 0
Brookwood	228	713 5 0
Boscawen	148	708 17 6
Wheal Emma	322	707 8 0
Copper Hill	205	705 19 0
Levant	130	667 17 6
Par Consols	173	632 10 6
Dolcoath	123	622 12 6
Gonamena	250	603 5 0
East Basset	100	598 14 6
East Grenville	137	562 5 0
Great Brigan	113	560 19 6
West Tolgus	117	541 14 0
Wheal Crebor	131	531 15 0
Nangiles	110	490 17 0
West Seton	1671	480 2 0
Wheal Curtis	104	437 6 6
St. Day United	104	421 7 0
Glasgow Caradon	143	400 19 0
Carn Camborne	136	379 4 0
Fursdon	119	352 5 6
Rosewarne Consols	50	344 8 0
North Downs	61	309 1 0
North Basset	106	303 1 0
Wheal Polmear	62	288 13 6
Tolvadden	77	283 3 0
Wheal Prudence	74	280 11 0
Wheal Buller	82	266 19 6
Boscaswell	27	260 4 6
Lady Bertha	99	256 9 6
West Stray Park	42	247 5 6
Pendeen Consols	62	244 10 0
Kelly Bray	65	223 12 6
North Grambler	41	220 12 6
Gunnislake	78	188 3 0
New Cornish	78	188 0 0
North Crofty	64	185 4 0
South Carn Brea	36	172 8 6
North Wheal Robert	35	168 17 6
Wheal Kitty	22	160 1 0
South Dolcoath	25	154 7 6
Grambler and St. Aubyn	30	153 0 0
Wheal Grenville	26	148 13 0
Mellanear	43	138 10 0
Tincroft	48	131 9 6
South Crinnis	15	129 0 0
Condurrow	28	128 2 0
Crane	18	109 7 0
Wheal Maudlin	18	87 5 0
Sortridge Consols	27	85 14 6
East Phœnix	31	82 3 0
South Condurrow	9	73 16 0
Wheal Arthur	30	69 0 0
Wheal Edward	34	68 0 0
Wheal Uny	12	63 18 0
Great Tregune	9	63 13 6
Crowan Consols	16	60 16 0
Wheal Harriett	9	58 19 0
Pedn-an-drea	13	47 2 6
Mount Carbis	6	45 12 0
West Grylls	14	45 2 0
Wheal Clarence	14	38 3 0
Osborne's Ore	13	35 5 0
Eny's Ore	9	29 18 6
Thomas's Ore	7	29 8 0
Buckingham's Ore	13	28 14 6
West Frances	7	24 6 6
South Basset	9	22 1 0
Grylls Florence	6	19 8 0
Wheal Lovell	3	5 8 0
Minasoda	2	2 9 0

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Vivian and Sons	4928	£26,069 5 7
Freeman and Co.	2256	11,444 7 0
P. Grenfell and Sons	3544	17,049 1 7
Sims, Willyams, Nevill, and Co.	4168	16,540 12 11
Williams, Foster, and Co.	6575	27,296 3 6
Mason and Elkington	4434	20,586 8 8
Bankart and Sons	2857	9,782 2 5
Copper Miners Co.	2920	10,519 12 9
Charles Lambert	3687	13,659 4 7
Newton, Keates, and Co.	592	2,948 12 8
Sweetland, Tuttie, and Co.	1368	7,106 17 4
Penclawdd Copper Co.	472	2,259 4 9
A. C. Hadland and Co.	903	1,655 12 6
Total	38,704	£167,917 5 6

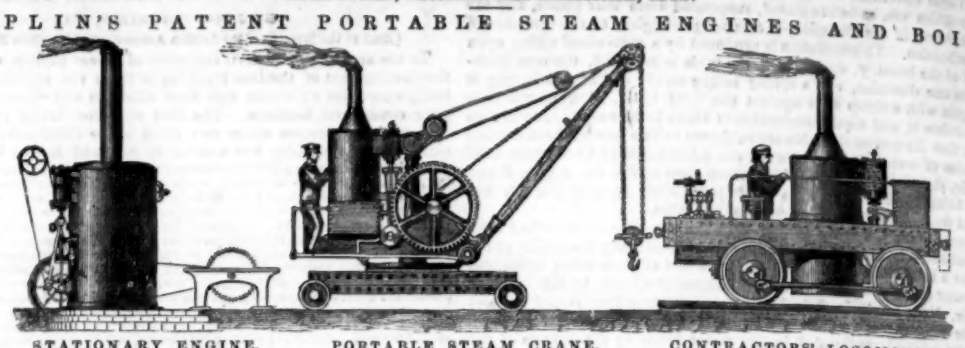
MANUFACTURE OF IRON AND STEEL.—Some improvements in the manufacture of iron and steel produced by the Bessemer process have been provisionally specified by Mr. Wm. Baker, of Sheffield. The object of the invention is to facilitate the removal of phosphorus and sulphur. He accomplishes this by adding from 10 lbs. to 20 lbs. of metallic zinc to the metal in the converter. The process is carried on in the usual manner.

IMPROVEMENTS IN PUMPS.—The improvements in lift and force pumps, patented by Mr. M. Benson, of Hinde-street, consist in so constructing them that the cylinder or barrel can be turned and secured to any joint within the range of its motion for bringing the discharge spout to any desired position; also in arranging the handle or lever for working the piston, so that it can be moved around the circumference of the cylinder, secured and worked from any point to suit the position of the pump. By this arrangement the pumps can be placed in cramped places, without being specially constructed for the purpose.

LONDON GENERAL OMNIBUS COMPANY.—The traffic receipts for the week ending November 19 was 10,601*l.* 14*s.* 11*d.*

Prize Medal, International Exhibition, 1862.

CHAPLIN'S PATENT PORTABLE STEAM ENGINES AND BOILERS.



STATIONARY ENGINE. From 1 to 30 horse power. PORTABLE STEAM CRANE. 1 to 30 tons. CONTRACTORS' LOCOMOTIVE. 6 to 27 horse power.

From the STRENGTH, SIMPLICITY, and COMPACTNESS of these ENGINES, they are now extensively used for general purposes; also in situations where steam-engines of the ordinary construction cannot be applied.

STATIONARY ENGINES,—require no building in, nor chimney stalk, and with our patent forced combustion apparatus will burn inferior qualities of coal, wood, or peat. These engines are specially suited for shipment, and may be packed inside the boiler, to economise freight.

PORTABLE STEAM CRANES,—for wharf or railway, with wrought-iron carriages on wheels, link motion, foot brake, &c., all under the easy control of one man; the larger sizes hoist, lower, and turn round in either direction by steam.—*These Cranes were selected by H.M. Commissioners for receiving and sending away the heavy machinery at the International Exhibition of* 1862.

CONTRACTORS' LOCOMOTIVES,—are adapted to work on rails or tramways, of a guage from 2 feet upwards. They are complete and efficient locomotives, simple in construction, and the working parts easily got at for repair. They draw heavy lodes at reduced speeds. These engines are usually sent in one package, ready for work on arrival.

LIGHT PORTABLE HOISTING, WINDING, AND PUMPING ENGINES, ETC.

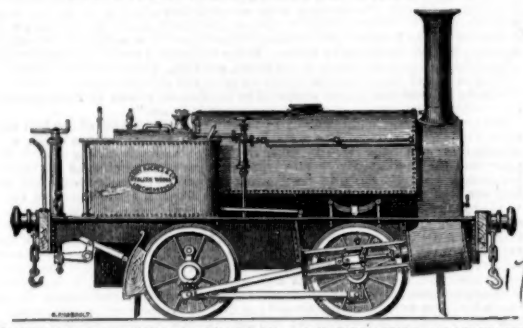
ALEXANDER CHAPLIN AND CO., CRANSTONHILL ENGINE WORKS, GLASGOW.

LONDON OFFICE,—9, ADAM STREET, ADELPHI, W.C. LONDON DEPOT AND WHARF,—LOWER FORE STREET, LAMBETH, S.

Several engines of each class KEPT IN STOCK, for SALE OR HIRE; and all our manufactures GUARANTEED as to EFFICIENCY, MATERIAL, and WORKMANSHIP.

Parties are cautioned against using or purchasing imitations or infringements of these patent manufactures.

HENRY HUGHES AND CO.,
FALCON RAILWAY PLANT WORKS,
LOUGHBOROUGH,
ENGINEERS, IRONFOUNDERS, BOILER MAKERS, and MANUFACTURER EVERY DESCRIPTION of RAILWAY MACHINERY.

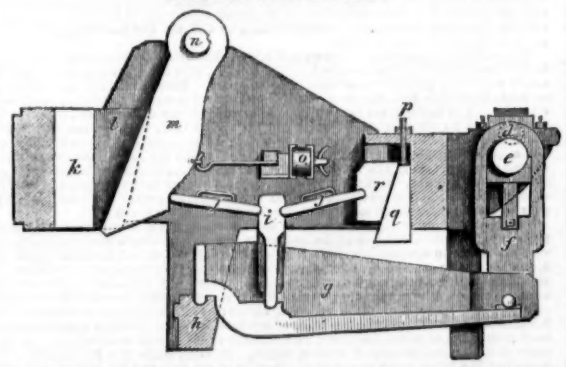


LOCOMOTIVE ENGINES, for MINERAL and CONTRACTORS' RAILWAYS, of the best materials and workmanship, always in progress. These engines are designed to supply the chief requisites in tank locomotives—viz., reduction of the overhanging weight at the fire-box end, proper distribution of the weight upon the wheels, and keeping the centre of gravity low. These are accomplished by making the fire-box and its shell on an improved principle, which enables the driving axle to be placed further back without interfering with the eccentrics and valve gear, which are of the usual simple description. LONDON OFFICES, 34, CANNON STREET WEST.

THOMAS TURTON AND SONS,
MANUFACTURERS OF
CAST STEEL for PUNCHES, TAPS, and DIES,
TURNING TOOLS, CHISELS, &c.
CAST STEEL PISTON RODS, CRANK PINS, CONNECTING RODS, STRAIGHT and CRANK AXLES, SHAFTS and
FORGINGS of EVERY DESCRIPTION.

DOUBLE SHEAR STEEL, BLISTER STEEL, SPRING STEEL, GERMAN STEEL. FILES MARKED T. TURTON. EDGE TOOLS MARKED WM. GREAVES & SON,
Locomotive Engine, Railway Carriage and Wagon Springs and Buffers.
SHEAF WORKS AND SPRING WORKS, SHEFFIELD.
LONDON WAREHOUSE, 35, QUEEN STREET, CANNON STREET, CITY, E.C., Where the largest stock of steel, files, tools, &c., may be selected from.

BLAKE'S PATENT STONE BREAKER,
OR ORE CRUSHING MACHINE,
FOR REDUCING TO SMALL FRAGMENTS ROCKS ORES, AND MINERALS OF EVERY KIND.



It is rapidly making its way to all parts of the globe, being now in profitable use in California, Washoe, Lake Superior, Australia, Cuba, Chili, Brazil, and throughout the United States and England.

The above section illustrates Blake's Stone Breaker, just as made the last five years and is fully protected in every part by patents.

Extract from Specification:—A short but powerful vibration is imparted to one or both of the jaws by any convenient arrangement, and combination of powerful levers, worked by a crank or eccentric on the main shaft.

LEGAL PROCEEDINGS will be taken at once against any person or persons found making, using, or vending any machine, the construction of which will constitute an infringement on the above patent. Read extracts of testimonials:—

Alkali Works, near Wednesbury.—I at first thought the outlay too much for so simple an article, but now think it money well spent. WILLIAM HUNT.

Welsh Gold Mining Company, Dolgelly.—The stone breaker does its work admirably crushing the hardest stones and quartz. WM. DANIEL.

Our 15 by 7 in. machine has broken 4 tons of hard winstone in 20 minutes, for 5s road metal, free from dust. Messrs. ORD and MADDISON, Stone and Lime Merchants, Darlington.

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General Frémont's Mines, California.—The 15 by 7 in. machine effects a saving the labour of about 30 men, or $75 per day. The high estimation in which we hol your invention is shown by the fact that Mr. Park has just ordered a third machine for this estate. SILAS WILLIAMS

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London: Published at the MINING JOURNAL office, 26, Fleet-street, E.C., and sold by all booksellers and newsagents.

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Published every Saturday, price 2d., or quarterly 2s. 2d.
Offices, 42, Grey-street, Newcastle-upon-Tyne; 50, Howard-street, North Shields; 195, High-street, Sunderland.

International Exhibition, 1862—Prize Medal.

JAMES RUSSELL AND SONS (the original patentees and first makers of wrought-iron tubes), of the CROWN PATENT TUBE WORKS, WEDNESBURY, STAFFORDSHIRE, have been AWARDED a PRIZE MEDAL for the "good work" displayed in their wrought-iron tubes and fittings.
Warehouse, 81, Upper Ground-street, London, S.

BICKFORD'S PATENT SAFETY-FUSE OBTAINED the PRIZE MEDALS at the ROYAL EXHIBITION of 1851, at the INTERNATIONAL EXHIBITION of 1862, in London, and at the IMPERIAL EXPOSITION, held in Paris, in 1855.

BICKFORD, SMITH, AND CO., TUCKINGMILL, CORNWALL, MANUFACTURERS of PATENT SAFETY-FUSE, having been informed that the name of their firm has been attached to fuse not of their manufacture, beg to call the attention of the trade and public to the following announcement:—
EVERY COIL of FUSE MANUFACTURED by them has TWO SEPARATE THREADS PASSING THROUGH the COLUMN of GUNPOWDER, and BICKFORD, SMITH, AND CO. CLAIM SUCH TWO SEPARATE THREADS as THEIR TRADE MARK.

BASTIER'S PATENT CHAIN PUMP, APPARATUS FOR RAISING WATER ECONOMICALLY, ESPECIALLY APPLICABLE TO ALL KINDS OF MINES, DRAINAGE, WELLS, MARINE, FIRE, &c.

J. U. BASTIER begs to call the attention of proprietors of mines, engineers, architects, farmers, and the public in general, to his new pump, the cheapest and most efficient ever introduced to public notice. The principle of this new pump is simple and effective, and its action is so arranged that accidental breakage is impossible. It occupies less space than any other kind of pump in use, does not interfere with the working of the shafts, and unites lightness with a degree of durability almost imperishable. By means of this hydraulic machine water can be raised economically from wells of any depth; it can be worked either by steam-engine or any other motive power, by quick or slow motion. The following statement presents some of the results obtained by this hydraulic machine as daily demonstrated by use:—

1.—It utilises from 90 to 92 per cent. of the motive power.
2.—Its price and expense of installation is 75 per cent. less than the usual pumps employed for mining purposes.
3.—It occupies a very small space.
4.—It raises water from any depth with the same facility and economy.
5.—It raises with the water, and without the slightest injury to the apparatus, sand, mud, wood, stone, and every object of a smaller diameter than its tube.
6.—It is easily removed, and requires no cleaning or attention.

BASTIER'S PATENT CHAIN-PUMP may be seen daily in operation at Messrs. SAMUEL BERGER AND CO.'s Patent Rice Starch Works, Bromley-by-Bow, London, E. Cards of admission to be had on application to the inventor and patentee, Mr. J. U. BASTIER, C.E.; or to Messrs. J. JACKSON and Co., Engineers, 17, Gracechurch-street, London.

J. U. BASTIER and Messrs. JACKSON and Co. will CONTRACT to ERECT the PATENT PUMP, and will GUARANTEE IT FOR ONE YEAR, or will grant licenses to manufacturers, mining proprietors, and others, for the use of this Invention.

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